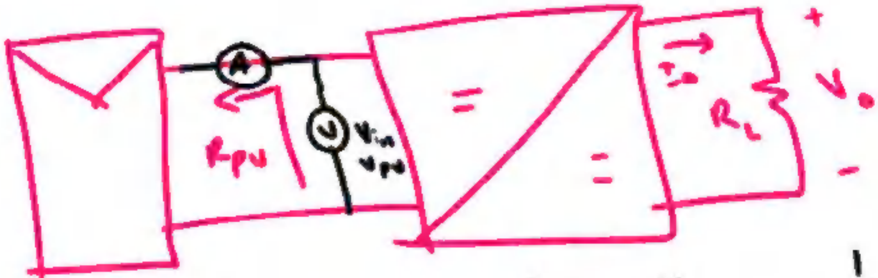
PV interfacing

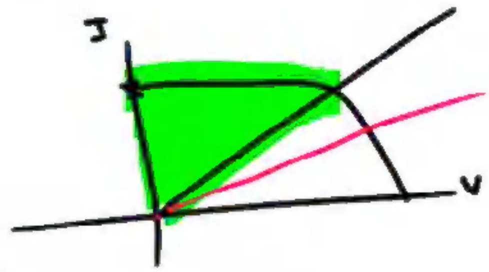
Monday, March 15, 2021 9:21 AM

Boost Converter



$$R_{pv} = \frac{V_{pv}}{I_{pv}} \qquad \frac{V_o}{V_{in}} = \frac{V_o}{V_{pv}} = \frac{1}{1-D} = \frac{I_{pv}}{I_o}$$

$$R_{pv} = \frac{(1-D)\,V_o}{\frac{I_o}{(1-D)}} = (1-D)^2 \frac{V_o}{I_o} = (1-D)^2 R_o$$

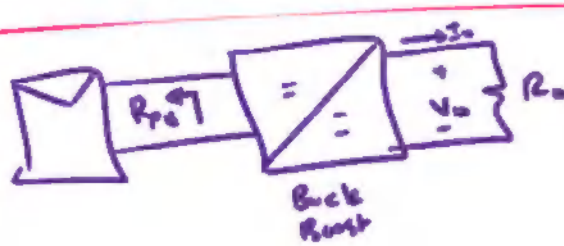


$R_{pv} = (1-D)^2 R_o$

If $D = 0$

$D = 1$

If $R_o < R_{pv}$ then boost interface can't track the MPP.



$$\frac{I_{pv}}{I_o} = \frac{V_o}{V_{pv}} = \left(\frac{D}{1-D}\right) \rightarrow R_{pv} = \frac{V_{pv}}{I_{pv}}$$

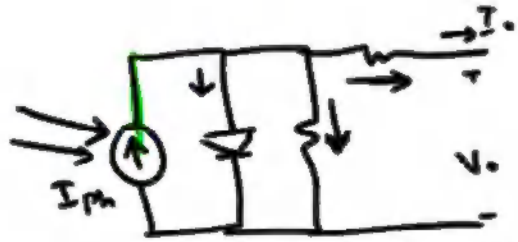
$$R_{pv} = \frac{\frac{(1-D)}{D} V_o}{\frac{D}{(1-D)} I_o} = \left(\frac{1-D}{D}\right)^2 R_o$$

If $D = 0$ $R_{pv} = \infty$

$D = 1$

If $D = 0$ $R_{pv} = \infty$

$D = 1$ $R_{pv} = 0$

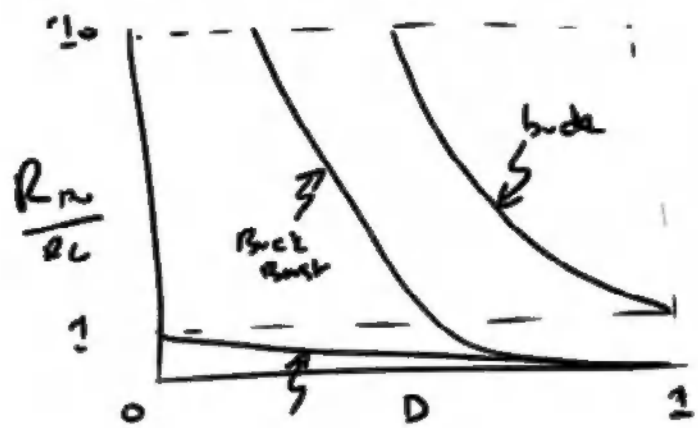


Buck → $D = \sqrt{\dfrac{R_o}{R_{pv}}} = \sqrt{\dfrac{1}{4.8}}$

$\underline{D = 0.45}$

Boost → $D = 1 - \sqrt{\dfrac{R_{pv}}{R_o}}$

Buck-Boost → $D = \dfrac{1}{1+\sqrt{\dfrac{R_{pv}}{R_o}}}$

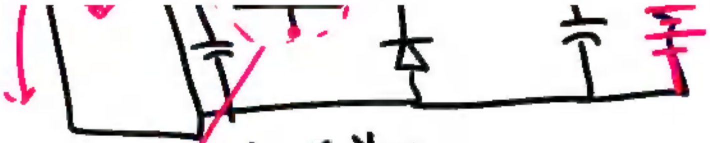


Buck $R_{pv} = \dfrac{R_L}{D^2}$

Boost $R_{pv} = R_L(1-D)^2$

→ If we use buck converter for PV, a large i/p capacitor is required.

→ Boost converter a large o/p capacitor is required.

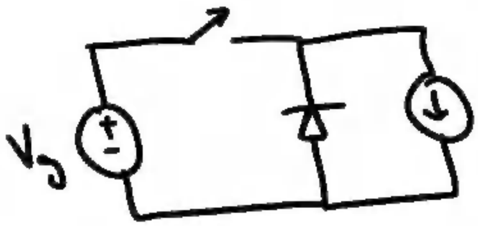


$V_o < V_{pv}$
$I_o > I_{pv}$

high side driver
Bootstrap circuitry is required

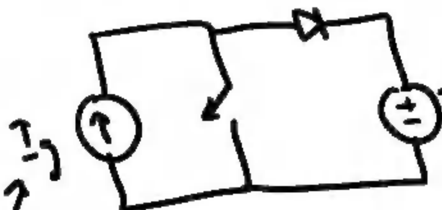
$V_o > V_{pv}$
$I_o < I_{pv}$.
Low side driver.

Converter eq. circuits



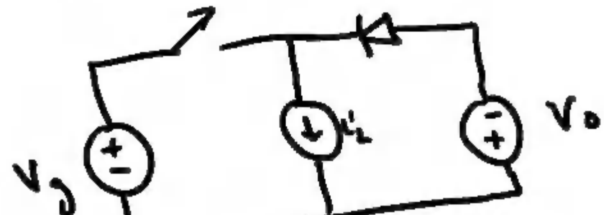
represent continuous conduction of inductor current.

→ Buck

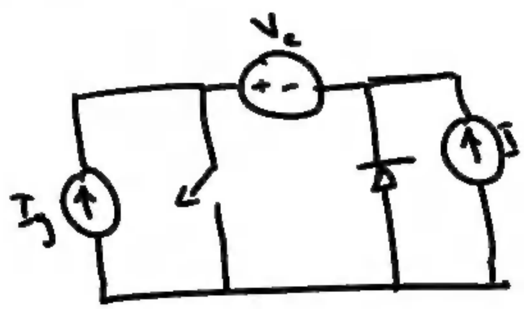


→ Boost

CCM of inductor which is placed at the i/p.

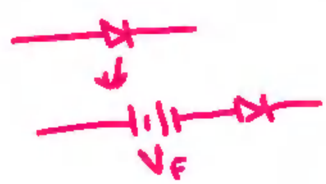


Buck-Boost converter.

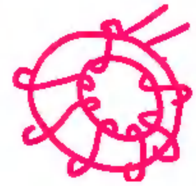


CÚK converter.

Chapter #3

→ 

→ Include non-idealities of components.

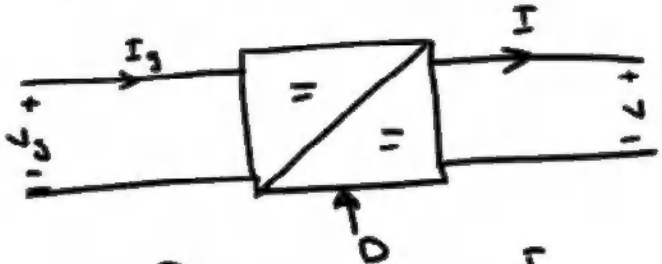


model concept.

→ Include non-idealities of components.

→ DC Transformer model concept.

DC Transformer model

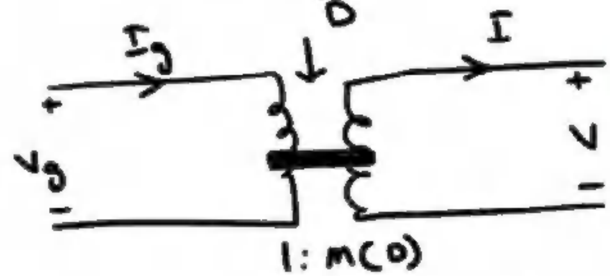


$P_{in} = P_{out}$

$V_g I_g = I V$ — (A)

$\boxed{V = V_g\,(m(D))}$ — (B)

$\boxed{I_g = I\,(m(D))}$ — (C)

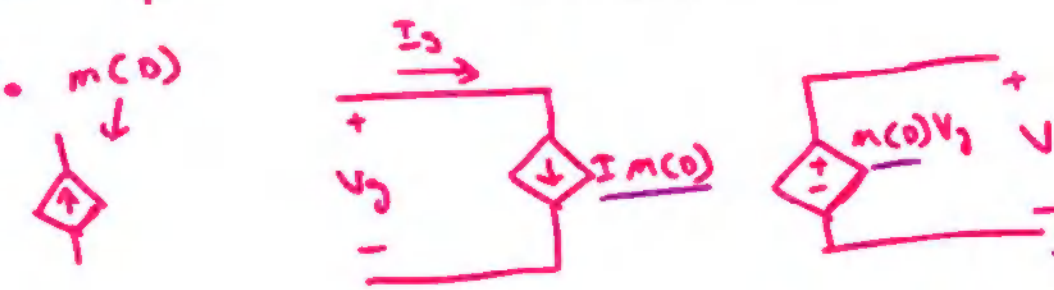


$m(D)$:
- $\to D \to$ Buck
- $\to \frac{1}{1-D} \to$ Boost
- $\to \frac{-D}{1-D} \to$ Buck-Boost

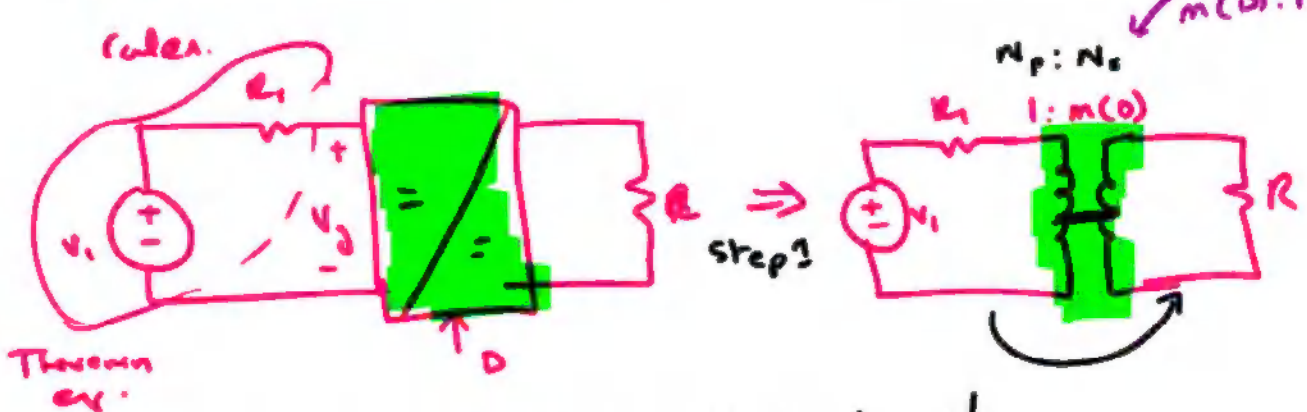
What is $m(D)$

For $V_0 = V_g\, m(D)$

For $I_g = I_0\, m(D)$



To model a converter like a T/f with all the rules.



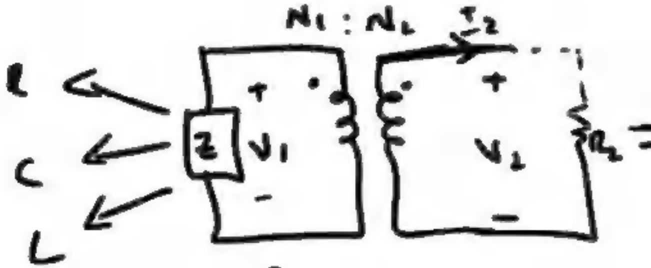
<u>step 2 :-</u> Push the i/p to the o/p.

on sec side → $m(D)\,V_1$

Step 2: Push

$$V_1 \xrightarrow{\text{on sec side}} m(D)\, V_1$$

$$I_1 \xrightarrow{\text{on sec side}} \frac{I_1}{m(D)}$$



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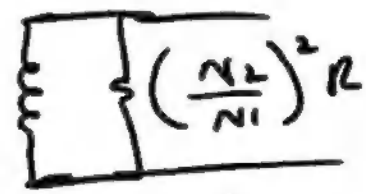
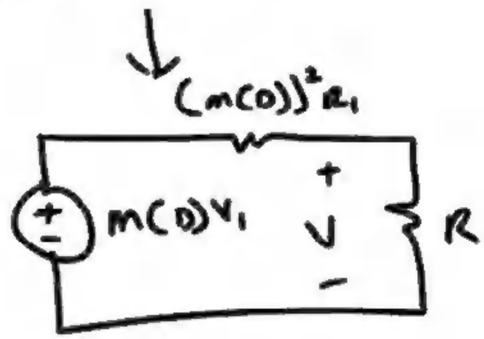


$$V_2 = \left(\frac{N_2}{N_1}\right) V_1$$

$$I_2 = \left(\frac{N_1}{N_2}\right) I_1$$

$$R_2 = \frac{V_2}{I_2} = \left(\frac{N_2}{N_1}\right)^2 \frac{V_1}{I_1}$$

$$R_2 = \left(\frac{N_2}{N_1}\right)^2 R_1$$



$$V = \frac{m(D) V_1 \times R}{R + m^2(D) R_1}$$